How far would it fall in, say, 9 seconds. Of course $9^2\ a$ or the sum of all the triangles in the first nine spaces.

With what velocity must a body be projected upward in order to rise during 10 seconds? Opposite 10 are 19 triangels so the initial velocity should be $19a$.

By a little thought any rule or problem in falling bodies can be *counted* out upon the diagram and it is unnecessary to commit any rule to memory as it can be produced at any moment from the diagram. Even the recollection will usually be sufficient to solve an ordinary problem as it has done with the inventor of the diagram—the writer—for thirty-five or forty years.

ERRATUM.—Owing to the extravagance of the compositor a needless *the* was inserted in the title of this paper.—PUBLISHERS.

ARITHMETIC.

Conducted by B.F.FINKEL, Kidder, Missouri. All Contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

38. Proposed by J. A. CALDERHEAD, B. Sc., Superintendent of Schools, Limaville, Ohio.

What must be the thickness of a 36-inch shell, in order that it may weigh 1 ton, supposing a 13-inch shell to weigh 200 pounds, when two inches thick.

IV. Solution by the PROPOSER.

$$200:2000::13^3-9^3:36^3-r^3;\text{ whence } r=31.74\text{ inches.}$$

$$\therefore\quad (36-31.74)\div2=2.13\text{ inches}=\text{thickness of 36-inch shell.}$$

39. Proposed by P. C. CULLEN, Superintendent of Schools, Brady, Nebraska.

A, B, and C start from same point at same time. A north at rate of three miles per hour, B east at rate of four miles and C west at rate of five miles per hour. B at end of two hours starts at such an angle as to intersect A. How long after starting must C start north-west in order to meet A and B at common point?

II. Solution by Professor H. W. DRAUGHON, Olio, Mississippi.

While B travels 8 miles east, A travels 6 miles north. The rest of A's distance north, and the distance B travels after turning, are in the ratio of 3 to 4. Since B's latter distance is on the hypothenuse of a right triangle, whose base is 8 miles and perpendicular, A's distance, we have from Geometry, (hypothenuse+8)(hypothenuse−8)=($\frac{3}{4}$hypothenuse+6)^2=$\frac{9}{16}$(hypothenuse+8)^2; whence, by division, we get hypothenuse−8=$\frac{9}{16}$(hypothenuse+8). $\therefore$ hypothenuse=$28\frac{4}{7}$ miles; and the perpendicular, = A's distance north,

$=\sqrt{(28\frac{4}{7})^2-8^2}=27\frac{3}{7}$ miles. Now C's route forms with A's route a right triangle whose perpendicular is $27\frac{3}{7}$. The sum of the hypothenuse and base $=C$'s distance $=\frac{5}{3}$ of A's distance $=27\frac{3}{7}\times\frac{5}{3}=45\frac{5}{7}$ miles. Also, from Geometry, the difference between the hypothenuse and base $=(27\frac{3}{7})^2\div45\frac{5}{7}=16\frac{16}{35}$ miles.

$\therefore$ Base $=\frac{1}{2}(45\frac{5}{7}-16\frac{16}{35})=14\frac{22}{35}$ miles. C's time in base is therefore, $14\frac{22}{35}\div5=2\frac{162}{175}$ hours $=2$ hours 55 minutes $32\frac{4}{7}$ seconds.

42. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

If $m=2$ct. be the interest on $M=100$ct. for $p=40$ days, find the yearly rate per cent.

I. Solution by P. S. BERG, Apple Creek, Ohio.

$\frac{1}{9}$ cent $=$ the interest on 100 cents for 40 days at 1%.

$2\div\frac{1}{9}=18$. Hence, 18 is the yearly rate per cent.

II. Solution by COOPER D. SCHMITT, Professor of Mathematics, Vanderbilt University, Knoxville, Tennessee.

If m is the interest on M cents for p days, then $\dfrac{m}{p}$ is the interest on M cents for 1 day, and $\dfrac{360m}{p}$ is the interest on M cents for 360 days.

Hence the per cent will be $\dfrac{360m}{p}$ of $100=\dfrac{36000m}{Mp}$ %. If $m=2, p=40$, and $M=100$, the rate is $\dfrac{72000}{100\times40}=18\%$.

Solutions of this problem were received from Professors *Matz* and *Zerr*.

43. Proposed by B. F. BURLESON, Oneida Castle, New York.

A, in a scuffle, seized on $\frac{2}{3}$ of a parcel of sugar plums; B caught $\frac{3}{8}$ of it out of his hands, and C laid hold on $\frac{3}{10}$ more: D ran off with all A had left, except $\frac{1}{7}$ which E afterwards secured slyly for himself; then A and C jointly set upon B, who, in the conflict, let fall $\frac{1}{2}$ he had, which were equally picked up by D and E, who lay perdu. B then kicked down C's hat, and to work they all went anew, for what it contained; of which, A got $\frac{1}{4}$, B $\frac{1}{3}$, and D $\frac{2}{7}$, and C and E equal shares of what was left of that stock. D then stuck $\frac{3}{4}$ of what A and B last acquired, out of their hands; they, with difficulty, recovered $\frac{5}{8}$ of it in equal shares again, but the other three carried off $\frac{1}{8}$ apiece of the same. Upon this, they called a truce, and agreed that the $\frac{1}{3}$ of the whole, left by A at first, should be equally divided among them. How much of the prize, after this distribution, remained with each of the competitors?

I. Solution by A. L. FOOTE, C. E., Middleburg, Connecticut.

First, A has $\frac{2}{3}$; second, A has $\frac{2}{3}-(\frac{3}{8}+\frac{3}{10})$ of $\frac{2}{3}=\frac{13}{60}$, B has $\frac{3}{8}$ of $\frac{2}{3}=\frac{1}{4}$, and C has $\frac{3}{10}$ of $\frac{2}{3}=\frac{1}{5}$; third, A has $\frac{13}{60}-(\frac{13}{70}+\frac{13}{420})=0$, B has $\frac{1}{4}$, C, $\frac{1}{5}$, D $\frac{6}{7}$ of $\frac{13}{60}=\frac{13}{70}$, and E, $\frac{1}{7}$ of $\frac{13}{60}=\frac{13}{420}$; fourth, A has 0, B has $\frac{1}{2}$ of $\frac{1}{4}=\frac{1}{8}$, C has $\frac{1}{5}$, D has $\frac{13}{70}+\frac{1}{16}=\frac{139}{560}$, and E has $\frac{13}{420}+\frac{1}{16}=\frac{157}{1680}$; fifth, A has $\frac{1}{4}$ of $\frac{1}{5}=\frac{1}{20}$, B has $\frac{1}{8}+(\frac{1}{3}$ of $\frac{1}{5})=\frac{23}{120}$, C has $\frac{1}{5}-(\frac{1}{20}+\frac{1}{15}+\frac{2}{35})=\frac{11}{420}$, D has $\frac{139}{560}+(\frac{2}{7}$ of $\frac{1}{5})=\frac{171}{560}$, and E has $\frac{157}{1680}$; sixth, A has $\frac{1}{20}-(\frac{3}{4}$ of $\frac{1}{20})=\frac{1}{80}$, B has $\frac{23}{120}-(\frac{3}{4}$ of $\frac{1}{15})=\frac{17}{120}$, C has $\frac{11}{420}$, D has $\frac{171}{560}+\frac{7}{80}=\frac{11}{28}$, and E has $\frac{157}{1680}$; seventh, A has $\frac{1}{80}+\frac{7}{256}=\frac{51}{1280}$, B has